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Nestar Cluster/One Model A

GATEWAY - Multiple Network Link

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ABSTRACT

This document describes the Gateway, a Server which allows users on a Network to access Servers on other Networks connected to the Gateway.

Server Description

The Gateway Server facility provides automatic connection of two to seven physically contiguous networks. A Gateway Server is an Apple II with Network Interface Cards in several slots. The Gateway Server runs the GATEWAY program, described herein, which monitors activity on all its attached networks and may be used to relay network messages between stations on physically distinct networks.

When the Gateway detects an incoming message on a Network interface card, it selects the card and reads the message. Messages are one of three types:

1. Commands to the Gateway
2. Virtual disk transfer requests (IOBs)
3. Other messages (server commands, etc)

When the Gateway receives a Gateway Command (any ascii message beginning with the word 'GATE'), it interprets and executes the command locally and does not forward it anywhere.

When an IOB is received, the drive number specified in the IOB is checked. If the Gateway has been previously instructed via a Gateway Command that when it receives an IOB with this particular drive number it should reroute the IOB message to a certain station on a certain network, it reroutes the IOB message to that station. Otherwise it routes it to a default station as described below.

Similarly, other messages are routed to a single station either explicitly defined or defaulted.

The default action of the Gateway is to forward any non-Gateway Command message that it receives to station $FE (typically the File Server) on the Network interface card in the highest numbered slot other than the Network interface card the message came in on. For example, if slots 4,5 and 7 contained Network interface cards, and if the message "SHOW MOUNTS" were received on slot 4 or slot 5, then by default the Gateway would forward the message to the File Server on slot 7. If the message had come in on slot 7, it would be forwarded to the File Server on slot 5.

Typical Uses

There are two primary uses of the gateway:

(1) As a network connector. The gateway may be used as the connection point between two to seven networks. Each network will typically have its own Network File Server (NFS) and user stations will by default access the NFS on their network. By using the gateway, users may access any of the NFS stations on any of the other networks. In this mode the gateway should probably be assigned the same station number ($C0, for example) on all the networks.

(2) As a network extender. The gateway may be used with only two network cards to extend the distance limitation of a local network segment. The primary network segment is the one to which the NFS is attached, and the gateway is a non-NFS station number (like $C0) on that network. The secondary network segment has no NFS, but the gateway is station $FE on the segment. Any station on the secondary segment which accesses $FE as an NFS for any purpose (including booting) will go through the gateway and access the $FE NFS on the primary segment.

Combination modes are possible, since a gateway may simultaneously be used as a multiple network connector and a network extender. Also, up to five network extender gateways may be connected in series.

Command Descriptions

Gateway Commands enhance the flexibilty of Gateway message rerouting. A Gateway routing command has the syntax:

```
    GATE [FROM <address>] [CMDS or DRIVE c1 [,c2 ...]]
     [TO [STN d] [SLOT e]] [AS STN f]
```

Items in square brackets are optional. An <address> has the syntax:

```
    <ALL or STN a> [SLOT b]
```

Examples of <address>'s are: 'ALL SLOT 3', 'STN 53', 'STN $22 SLOT 5', 'ALL'. Three examples of <u>illegal</u> <address> clauses are 'ALL or STN 100', 'ALL STN $39', and 'SLOT 6'. In general, if 'ALL' is specified it means apply the Gateway command to all the stations on the given slot. If no slot is given and 'ALL' is specified, the Gateway command is applied to all stations on all networks connected to the Gateway. Some commands require that if 'ALL' or 'STN a' are specified, than a SLOT be specified as well. These exceptions are noted below.

In a Gateway Command, "FROM <address>" means that the rerouting to be described should be applied to messages received from the given address, either station number 'a' on slot number 'b' if 'STN a [SLOT b]' is specified, or all the stations on slot number 'b' if 'ALL' is specified. If 'SLOT b' is omitted, it defaults to the slot number of whoever sent this Gateway Command. 'SLOT b' <u>must</u> be specified if 'ALL' is specified. If no "FROM" clause is present at all, then the station number and slot number default to the station and slot numbers of whoever sent the command. E.g. "FROM STN $50 SLOT 6", "FROM STN 22", "FROM ALL SLOT 3". Note that "FROM ALL" will generate an error message "KEYWORD SLOT EXPECTED" if not followed by 'SLOT b'. The use of the "FROM' phrase is prohibited if Gateway Security is active. See the description of <u>Gateway Security</u> below.

"CMDS" specifies that this rerouting pertains to messages received that are not Gateway Messages or IOBs.

"DRIVE c1, c2..." specifies that this rerouting pertains to messages containing IOBs which request I/O on drive numbers 'c1', 'c2', etc. E.g. "DRIVE 5, 74", "DRIVE $A". Note that drive numbers can also be specified by omitting the keyword "DRIVE" and preceding the drive numbers with the letter "D". "D5, D74" and "D$A" are equivalent to the examples given above. No space is allowed between the "D" and the drive number.

If neither "CMDS" nor "DRIVE c1 ..." is specified, "CMDS" is used as the default.

"TO [STN d] [SLOT e]" means that the Gateway should reroute messages to the specified station on the specified slot. The station number defaults to $FE; the slot number defaults to the Network interface card on the highest number slot in the Gateway Server Apple other than the slot the message was received on. "ALL" may not be used in a "TO" clause. Its use will result in an "UNRECOGNIZED SYMBOL" error. Examples of legal "TO" clauses are "TO STN 21 SLOT 4", "TO STN $FD", "TO SLOT 6". The last of these examples, "TO SLOT 6", implies the default station number of $FE. Note that either "STN", "SLOT", or both must be specified after the "TO" keyword. If neither is specified, the error message "KEYWORD SLOT EXPECTED" will be generated.

"AS STN f" specifies the 'masquerade' station number. If a masquerade station number is given, then when the Gateway reroutes messages it will forward the message along as though it came from station number 'f', even though in reality it came from station number 'a'. If no masquerade station number is given, then messages are forwarded as originating from station 'a'. If "FROM ALL SLOT b" was specified and no masquerade station number is given, then messages are forwarded as originating from the station number the Gateway received the message on. Sample valid "AS" clauses are "AS STN 80", "AS STN $50". The use of this phrase is prohibited if Gateway Security is active. See the description of Gateway Security below. The use of the keyword "ALL" in this phrase is prohibited.

Note that any token more than 40 characters long is truncated to 40 characters.

When the Gateway is given a grammatically correct Command, it executes the command and sends back to the user station a text message containing the command with the defaults filled in. For example, if you are station $01 on slot 6, and Network interface cards exist on slots 4,5 and 6 of the Gateway Apple, then the following commands will generate the following underlined responses:

```
    : GATE DRIVE 6 AS STN $05
    GATE FROM STN $01 SLOT 6 DRIVE 6 TO STN $FE SLOT 5 AS STN $05

    : GATE FROM STN $06 D7, D8 TO STN $FD SLOT 4
    GATE FROM STN $06 SLOT 6 DRIVE 7 TO STN $FD SLOT 4 AS STN $06
    GATE FROM STN $06 SLOT 6 DRIVE 8 TO STN $FD SLOT 4 AS STN $06

    : GATE
    GATE FROM STN $01 SLOT 6 CMDS TO STN $FE SLOT 5 AS STN $01

    : GATE FROM ALL SLOT 4
    GATE FROM ALL SLOT 4 CMDS TO STN $FE SLOT 6 AS <SENDER>
```

```
: GATE FROM ALL SLOT 5 D243 AS STN $DD
GATE FROM ALL SLOT 5 DRIVE 243 TO STN $FE SLOT 6 AS STN $DD
```

Note that a routing that is to apply to "ALL" stations on a given slot is used as a "default" routing. For example, if the following commands are entered in any order:

```
: GATE FROM STN 20 SLOT 5 DRIVE 19 TO STN $FE SLOT 6
GATE FROM STN $14 SLOT 5 DRIVE 19 TO STN $FE SLOT 6 AS STN $14
```

and

```
: GATE FROM ALL SLOT 5 DRIVE 19 TO STN $01 SLOT 4
GATE FROM ALL SLOT 5 DRIVE 19 TO STN $01 SLOT 4 AS <SENDER>
```

then an IOB specifying drive 19 that is received by the Gateway on slot 5 will be routed to station 1 on slot 4 unless the IOB is from station 20, in which case it will be routed to station $FE on slot 6. In other words, specifying "FROM ALL SLOT b" sets up a default path for the given type of message ("CMDS" or some particular drive numbers) received by the Gateway from any station on slot 'b'; the default may be overridden by an explicit Gateway command or another "FROM ALL SLOT b" command.

The Gateway also recognizes three other types of Gateway Commands: "GATE STATUS", "GATE CLEAR", and "GATE SYMBOL". The Gateway paths for a given station on a given slot can be displayed by the command:

```
GATE STATUS <address>
```

where the station and slot numbers default to the station and slot numbers of whoever sent the Gateway Command. A command of the form:

```
GATE STATUS ALL SLOT b
```

will list all of the paths the Gateway has been given for messages received on slot 'b', and a command of the form:

```
GATE STATUS ALL
```

will list all the paths the Gateway contains.

A command with the form

```
GATE CLEAR <address>
```

will clear all Gateway paths for station 'a' on slot 'b'. Any messages (including IOBs) from station 'a' on slot 'b' will now be rerouted along the default path (i.e. to the file server on the Network interface card in the highest numbered slot other than slot 'b'). If "ALL SLOT b" is specified, then all the Gateway paths for messages received on any station on slot 'b' will be deleted. If "ALL" is specified without any constraining slot number, all Gateway paths for all stations on all slots will be deleted. The use of this command is restricted if Gateway Security is active. See the description of Gateway Security below.

The command

```
GATE SYMBOL [<symbol> ...]
```

will list the translations for the given symbols. If no symbols are specified, all of the Gateway symbols and their translations will be listed. See the description of Gateway Symbols below.

Finally, the Gateway is sensitive to commands of the form:

```
GATE GATE <Gateway Command>
```

In this special case, the Gateway strips off the first 'GATE' and then reroutes the message as though it were a non-Gateway Command. This feature allows Gateway Commands to be passed to any particular Gateway in a string. For example, if Gateway #1 is rerouting a particular batch of messages to Gateway #2, and Gateway #2 is rerouting those messages to Gateway #3, then commands of the form

```
GATE GATE <Gateway Command>
```

will be interpreted by Gateway #2, and commands of the form

```
GATE GATE GATE <Gateway Command>
```

will be interpreted by Gateway #3.

Setting Up A Gateway Profile

When the Gateway Server is executed, it attempts to open the file "*:GATECMD.TEXT". If the file is present, lines within it are assumed to be Gateway Commands. Commands may be preceded by the optional keyword 'GATE', which itself may be followed by an optional colon (':'). Thus the following lines, for example, may appear in "*:GATECMD.TEXT":

```
FROM STN $01 SLOT 4 DRIVE 9,10 TO STN $FD SLOT 6 AS STN $02
GATE STATUS ALL
STATUS ALL
CLEAR STN $99 SLOT 7
FROM ALL SLOT 5 TO STN $F0 SLOT 7
GATE : CMDS
```

The commands will be executed as though they had been received as messages to the Gateway via a Network. Note, however, that the default 'STN' and 'SLOT' values are unpredictable, and should be specified. An illegal command will generate an error message on the Gateway Server display, and processing of the file will continue.

Commands of the form 'GATE GATE' are NOT allowed in the Defaults file.

In addition to normal Gateway Commands, seven other Commands are recognized if present in "*:GATECMD.TEXT": 'DISPLAY', 'TRACE', 'SECURE', 'UNSECURE', 'ACCESS', 'NOACCESS', and 'DEFINE'.

The command 'DISPLAY <ON/OFF>' controls the Gateway Server Display Mode. If Display is ON, all text messages the Gateway sends in response to user commands will be displayed on the Gateway Server Apple. If Display is OFF, responses will not be displayed. The default is OFF. E.g. 'DISPLAY ON', 'DISPLAY OFF'.

The command 'TRACE <#>' sets the Gateway Server Trace Level. The Trace Level is a number from 0-9. A value of 0 specifies that no trace information is to be displayed on the Gateway Server Apple. A value of 9 specifies that ALL trace information should be displayed; this results in a lot of text being written. Only the first digit is used, thus 'TRACE 3' and 'TRACE 3.1415926' are equivalent. The default value is 0.

Gateway Security

The command 'SECURE' activates Gateway Security. This option enables protection of Network systems from possible security violations resulting from use of the Gateway Server. When Gateway Security is active, 'GATE FROM ...', 'GATE ... AS', and 'GATE CLEAR <address>' commands are not allowed, assuring that a user cannot alter another user's Gateway Paths nor can a user masquerade as another user. The Gateway Path syntax becomes:

```
    GATE [CMDS or DRIVE c1 [,c2 ...]] [TO STN d [SLOT e]]
```

and the Gateway Clear command syntax is simply:

```
    GATE CLEAR
```

All other Gateway commands are permitted, subject to any other restrictions specified in the GATECMD file (see 'NOACCESS' below).

The command 'UNSECURE' deactivates Gateway Security, allowing full use of Gateway Commands. The default mode is SECURE.

The command 'NOACCESS <address>' denies access to the Gateway by the given station on the given network. All commands directed to the Gateway from the station will be rejected with an error message. Any IOB's from the station that the Gateway receives will be returned with the IOB status set to $40 (64 decimal) indicating an unusual error occurred. The station may still receive messages from other stations which are using the Gateway. If 'ALL SLOT b' is specified, then messages received from any station on slot 'b' will be rejected. A station number or 'ALL' must be specified, and a slot number must be specified. If they are not, an error message will be displayed on the Gateway Server console and processing of the file will continue.

The command 'ACCESS <address>' enables the given station on the given network to access the Gateway. A station number or 'ALL' must be specified, and a slot number must be specified. By default all stations have access to the Gateway.

Gateway Symbols

The command 'DEFINE <symbol> AS <translation>' in the Gateway Profile instructs the Gateway that whenever it encounters <symbol> in a Gateway command, it is to convert <symbol> into <translation>. A <symbol> is any series of characters not including blanks or commas. Symbols are significant to 16 characters and symbol recognition is not case-sensitive. The symbol must be followed by the keyword 'AS'. Whatever follows the 'AS' keyword is taken to be the translation for the symbol. For example, the following command in the Gateway Profile:

```
DEFINE joe's-network AS slot 2
```

will define the symbol "JOE'S-NETWORK" as "SLOT 2". Once this definition has been entered,

```
GATE TO Joe's-Network
```

is entirely equivalent to

```
GATE TO SLOT 2
```

Symbols may refer to other symbols. If, however, a symbol directly or indirectly refers to itself, the Gateway will endlessly loop attempting to resolve the symbol's translation. The symbols available to the user may be displayed using the

```
GATE SYMBOL [<symbol> ...]
```

command as described above. In our previous example,

```
GATE SYMBOL joe's-network
```

would return

```
JOE'S-NETWORK == SLOT 2
```

A list of all of the active symbols can be generated by simply typing 'GATE SYMBOLS'.

The above seven commands can only be issued from the "*:GATECMD.TEXT" file, which is read only once upon execution of the Gateway Server. The commands all take immediate effect, so a sequence like:

```
SECURE
CLEAR STN $01
```

would generate an error message because the 'CLEAR <address>' syntax violates Gateway Security. Of course,

```
SECURE
CLEAR
```

would be legal. The sequence would result in Gateway Security being activated, and the paths for the (unpredictable) default station number on the default slot number being cleared.

Gateway access could be enabled for only a few stations on a certain slot by using:

```
NOACCESS ALL SLOT n
ACCESS STN a SLOT n
ACCESS STN b SLOT n

           .
           .
           .
```

Abbreviations

In all contexts (i.e. in both Gateway Commands present in the profile file and those entered by users interactively) all keywords except 'GATE' may be abbreviated to three characters. The cmd

```
GATE GATE FROM STN $01 SLOT 5 DRIVE 1,2,101 TO STN $02 SLOT 6 AS STN $03
```

may be abbreviated as

```
GATE GATE FRO STN $01 SLO 5 DRI 1,2,101 TO STN $02 SLO 6 AS STN $03
```

and

```
GATE STATUS ALL
```

as

```
GATE STA ALL
```

for example.

Using The Gateway

To use the Gateway, the user should execute the 'CMD' program (presumably on 'PASCAL:') and use the "SET NFS" command to set the Network File Server station number to the Gateway Server's station number on the user's network. Next, the user issues appropriate Gateway Commands if the user does not want messages being routed along the default path. Any Pascal virtual drives whose data is to be routed through the Gateway should be made virtual to the Gateway station with the "SET DRIVE" command. The user then accesses the desired files or servers on the other network. When all done, the user should issue a "GATE CLEAR" command to ensure that the next time she or he uses the Gateway there won't be any Gateway Paths left over from this usage. Finally, the user needs to issue another "SET NFS" to restore the Network File Server station number to the Server that was being used before the Gateway.

Note that since the Gateway can be addressed with different station numbers on the different networks it is connected to, it is possible to transparently extend the apparent size of a network beyond the network's physical limitations. For example, suppose network 'A' has reached its maximum size due to limitations on the length of the network bus. A Gateway Server could be added to this network, interfacing network 'A' with network 'B'. Network 'B' would consist only of user stations and the Gateway Server; no file server would be present. The Gateway Server's address on Network 'B' would be station $FE, however, so when users on Network 'B' did any I/O (including booting), the messages intended for a file server would be received by the Gateway, since it occupies the default file server address, and (by default) the Gateway would forward the messages to the file server on network 'A'. With this arrangement, user stations on network 'B' would be indistinguishable from user stations on network 'A', though between the two networks only one file server would be needed, and the effective length of the network bus would be doubled.

Error Messages

Invalid Gateway Commands can generate the following error messages:

201,UNRECOGNIZED SYMBOL: <symbol>
The Gateway Command is syntactically incorrect. <symbol> is the symbol that was unrecognized. For example, 'GATE STN $04' will generate the error message '201,UNRECOGNIZED SYMBOL: STN', since the user forgot to precede 'STN' with 'FROM'.

202,KEYWORD STN EXPECTED
E.g. "GATE FROM $FE". The word 'STN' was expected after the keyword 'FROM'.

203,ILLEGAL STATION NUMBER SPECIFIED
Station numbers can range from 1 to 254 ($1 to $FE).

204,NUMBER EXPECTED
E.g. "GATE FROM STN CMDS": the station number was expected after the keyword 'STN'; "GATE TO STN $42 SLOT AS STN $20": the slot number was expected after the keyword "SLOT". Note also that 'GATE DRVE 8' will generate this error message. The Gateway mistakes the misspelled 'DRVE' for a drive list of the form 'Dn' (e.g. D12), and since the first character after the 'D' is 'R', and not a drive number, the Gateway tells the user that a number was expected but not found.

205,ILLEGAL DRIVE NUMBER SPECIFIED
Drive numbers can range from 1 to 255.

206,NUMBER OUT OF RANGE
In general, numbers can range from 0 to 255.

207,KEYWORD SLOT EXPECTED
E.g. "GATE FROM ALL TO STN $FD ..." will generate this error because using "ALL" in a "FROM" clause requires a "FROM" slot number to be specified as well. The line "NOACCESS STN $20" in the "*:GATECMD.TEXT" file will generate this error message because BOTH the station number and the slot number must be specified in a 'NOACCESS' command. If the line was changed to "NOACCESS STN $20 SLOT 6" then no such error would result.

208,ILLEGAL SLOT NUMBER SPECIFIED
Slot numbers can range from 0 to 7. This message is also generated if the 'from' slot number is the same as the 'to' slot number.

209,SLOT HAS NO NETWORK CARD
The Gateway has no Network card in the slot the user specified.

210,COMMAND UNSECURE: <symbol>

The Command issued would normally be legal, but Gateway Security is active, so the Command is illegal. <symbol> is the beginning of the offending phrase. E.g. "GATE AS STN $01" would generate a "210,COMMAND UNSECURE: AS" reply, and "GATE CLEAR STN 99 SLOT $4" would generate "210,COMMAND UNSECURE: STN". A "GATE FROM ..." command generates "FROM" as the offending symbol.

211,NO GATEWAY ACCESS ALLOWED FROM STATION

The user has sent an ascii message to the Gateway (not necessarily a Gateway command, but any type of ascii message) from a station which has been deprived of access to the Gateway by a 'NOACCESS' command in the Gateway profile.

212,GATEWAY MEMORY OVERFLOW

The Gateway has run out of memory in which to store Gateway paths and symbol translations. Memory for additional Gateway paths can be obtained by CLEARing some Gateway paths no longer needed.

213,KEYWORD AS EXPECTED A symbol definition neglected to include 'AS' between the symbol and its translation. E.g. 'DEFINE JOE'S-NETWORK SLOT 2'. The correct form is 'DEFINE JOE'S-NETWORK AS SLOT 2'.

Sample Use

Suppose the Gateway Server has two Network interface cards in it, one for Network 'X' in slot 4 and one for Network 'Y' in slot 6. Furthermore, Network 'X' supports two file servers of station numbers $FD and $FE. If you were at a user station $01 on Network 'Y' and wished to transfer a file in '/MAIN/TEST/SAMPLE' on the $FD file server on Network 'X' to '/MAIN/QUIZ/EXAMPLE' on the $FE file server on Network 'X', and if the Gateway Server was station $C0 on Network 'Y', you would issue the following commands to the CMD program:

```
: set nfs stn $c0
: gate to stn $fd
GATE FROM STN $01 SLOT 6 CMDS TO STN $FD SLOT 4 AS STN $01
: mount /main/test/sample,d12
: set drive 12 stn $c0
: gate drive 12 to stn $fd
GATE FROM STN $01 SLOT 6 DRIVE 12 TO STN $FD SLOT 4 AS STN $01
: gate
GATE FROM STN $01 SLOT 6 CMDS TO STN $FE SLOT 4 AS STN $01
: mount /main/quiz/example,d11,upd
: set drive 11 stn $c0
<here you would exit CMD and use the filer to transfer the file from
volume 12 to volume 11>
```

Note that you didn't have to GATE drive 11 to the $FE file server. Since drive 11 does not have a Gateway path associated with it, it will take the default path. The default path from station $01 on slot 6 is to station $FE on slot 4. You DID have to GATE drive 12 to the $FD file server, because you didn't want that drive to be associated with station $FE on the 'X' network.

If with the same multiple-network setup you wanted to transfer a file on /MAIN/TEST/SAMPLE to /MAIN/PRUFUNG/BETA, and if /MAIN/PRUFUNG/BETA was on station $FD on network 'Y', you would enter the following commands to the CMD program:

```
: set nfs stn $c0
: gate to stn $fd
GATE FROM STN $01 SLOT 6 CMDS TO STN $FD SLOT 4 AS STN $01
: mount /main/test/sample,d12
: set drive 12 stn $c0
: gate drive 12 to stn $fd
GATE FROM STN $01 SLOT 6 DRIVE 12 TO STN $FD SLOT 4 AS STN $01
: set nfs stn $fd
: mount /main/prufung/beta,d11,upd
: set drive 11 stn $fd
<here you would exit CMD and use the filer to tranfser the file from
volume 12 to volume 11>
```

If you wanted to clean up after the file transfer, you would again enter CMD and issue the following commands:

```
: set nfs stn $fd
: unmount d11
: set drive 11 stn $fe
: set nfs stn $c0
<recall that unless you have issued some intervening Gateway
commands, commands you type to the Gateway will be forwarded
to station $fd on slot 4.  You can make sure of this by
checking the Gateway status.>
: gate status
  GATE FROM STN $01 SLOT 6 DRIVE 12 TO STN $FD SLOT 4 AS STN $01
  GATE FROM STN $01 SLOT 6 CMDS TO STN $FD SLOT 4 AS STN $01
: unmount d12
: set drive 12 stn $fe
: gate clear
: set nfs stn $fe
```